Photogrammetry with small rotary UAS to assess the size, growth and body condition of whales

John Durban[1], Holly Fearnbach[1], Lance Barrett-Lennard[2], Michael Moore[3], Don LeRoi[4], Wayne Perryman[1]

[1]*Marine Mammal and Turtle Division, Southwest Fisheries Science Center, National Marine Fisheries Service, National Oceanographic Atmospheric Administration, 89101 La Jolla Shores Drive, La Jolla, CA 92037, U.S.A., john.durban@noaa.gov*

[2]*Vancouver Aquarium Marine Science Center, 845 Avison Way, Vancouver, BC, VG63E2, Canada*

[3]*Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA 02543, U.S.A.*

[4]*Aerial Imaging Solutions, 5 Myrica Way, Old Lyme, CT 06371, U.S.A.*

Since 2014 we have successfully completed >1000 flight missions with a small, unmanned hexacopter (APH-22, Aerial Imaging Solutions) to collect vertical images of whales. This has included missions flown from a variety of marine platforms, ranging from small inflatable boats (16ft) to small ships (85ft), and also flying over water from sites on shore. This talk details the features of the aircraft, camera setup and our flight methods that enable quantitative photogrammetry measurements to provide data on the body condition, size and growth of free-swimming whales. These features include a ground resolved distance of <1.4cm in photographs taken from an altitude of 30m (100ft), which allows individual whales to be recognized and monitored using natural markings and enables even subtle changes in whale shape to be detected. Altitude measurements from an onboard pressure sensor allow measurements to be scaled to real size with a typical error of <1%, representing just a few centimeters in whales measuring several meters or more in length. A powered gimbal for camera stabilization minimizes off-vertical images that can result in image distortion and biased photogrammetry calculations, and increases efficiency in capturing usable photographs of mobile whales. Applications include monitoring the nutritional and reproductive status of endangered Southern Resident killer whales, assessing patterns of growth in endangered North Atlantic Right whales and estimating the size and body condition of blue whales.